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KlimaCampus

Evaluation of concentration simulations for remote and two urban areas

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11 EMS, 12 – 16 September 2011,
Berlin

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» Are regional chemical transport models (CTM) able to simulate urban pollutant concentrations? «

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Evaluation of integrated tools

Determining the applicability of CTMs:

- **Operational evaluation**
  - Testing the timing of observed and simulated values
- **Evaluation neglecting timing**
  - Checking the statistic properties like number of exceedances
- **Evaluation with classification of weather types**
  - Testing the reliability of model results for different meteorological situations

Methods – Operational evaluation

- **Annual means, Correlation, Skill variance and Hit rates (H)**

- **Main pollutants: particulate matter (PM), ozone (O_3) and nitrogen dioxide (NO_2)**

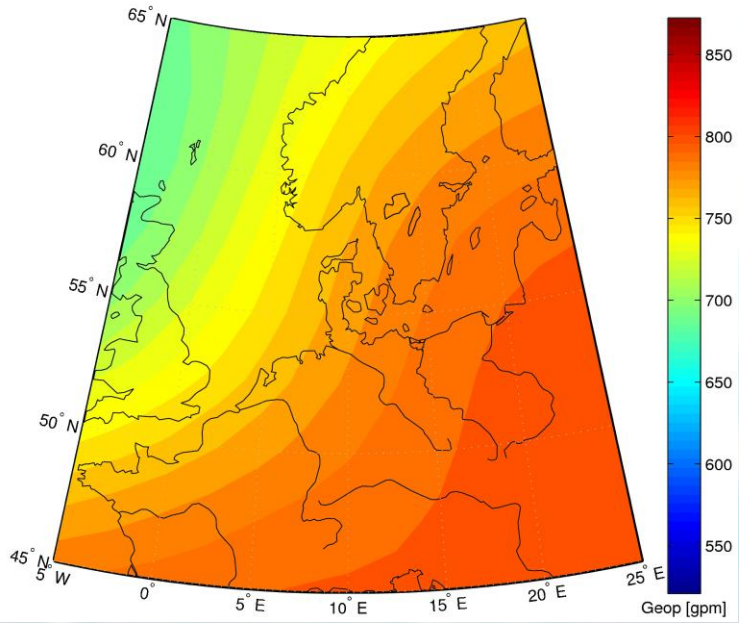
Methods – Evaluation neglecting timing

- **Probabilistic evaluation**
- **Number of exceedances, timing not essential**
- **Accumulated concentrations over threshold value**

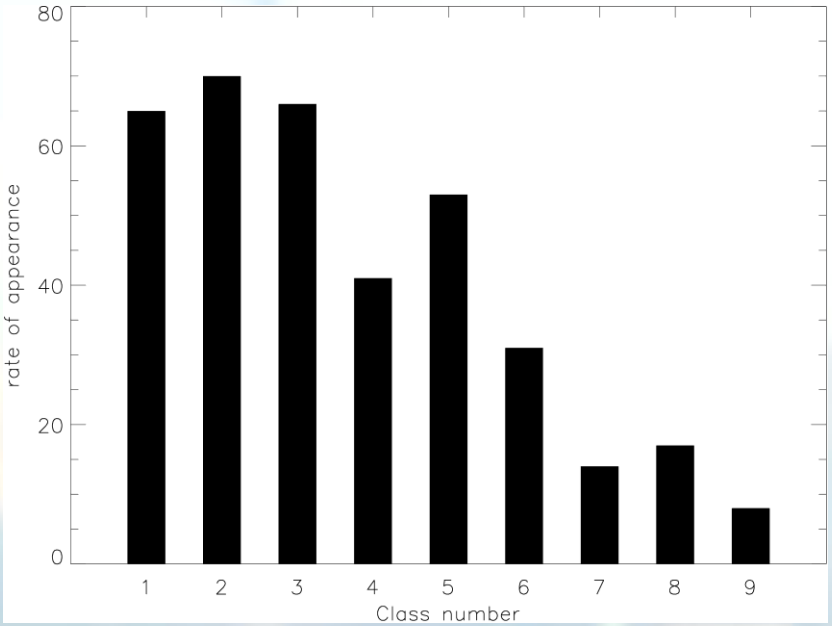
$$AOT40 = \int_{t=0}^{T} \max(O_3 - 40ppb, 0.0)\, dt$$

Methods – Classification scheme

- Clustering algorithm dividing year 2005 in 9 weather types (P. Hoffmann)
- K-means method
- NCEP reanalysis 2.5°, 925 hPa geopotential



Weather type 2



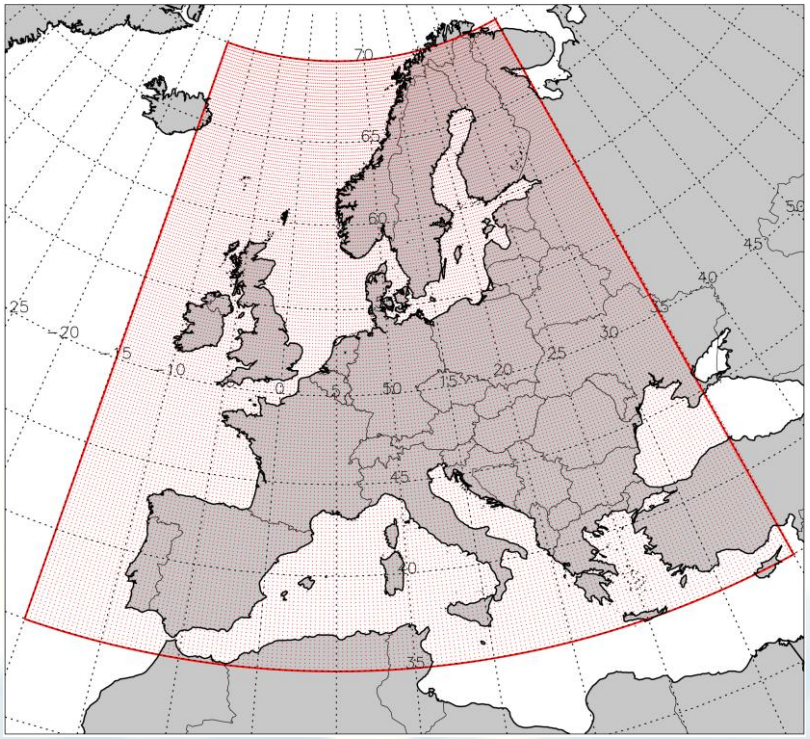
Rate of appearance of each class in 2005

Model data

- **Five model simulations for whole year 2005:**

  CHIMERE, FARM, SILAM, LOTOS-EUROS, WRF-CMAQ

- **Hourly resolution, 0.2 x 0.3° horizonal resolution and 5 vertical levels, 168x179 grid points**
- **Meteorological input data (e.g. ECMWF, MM5, RAMS)**



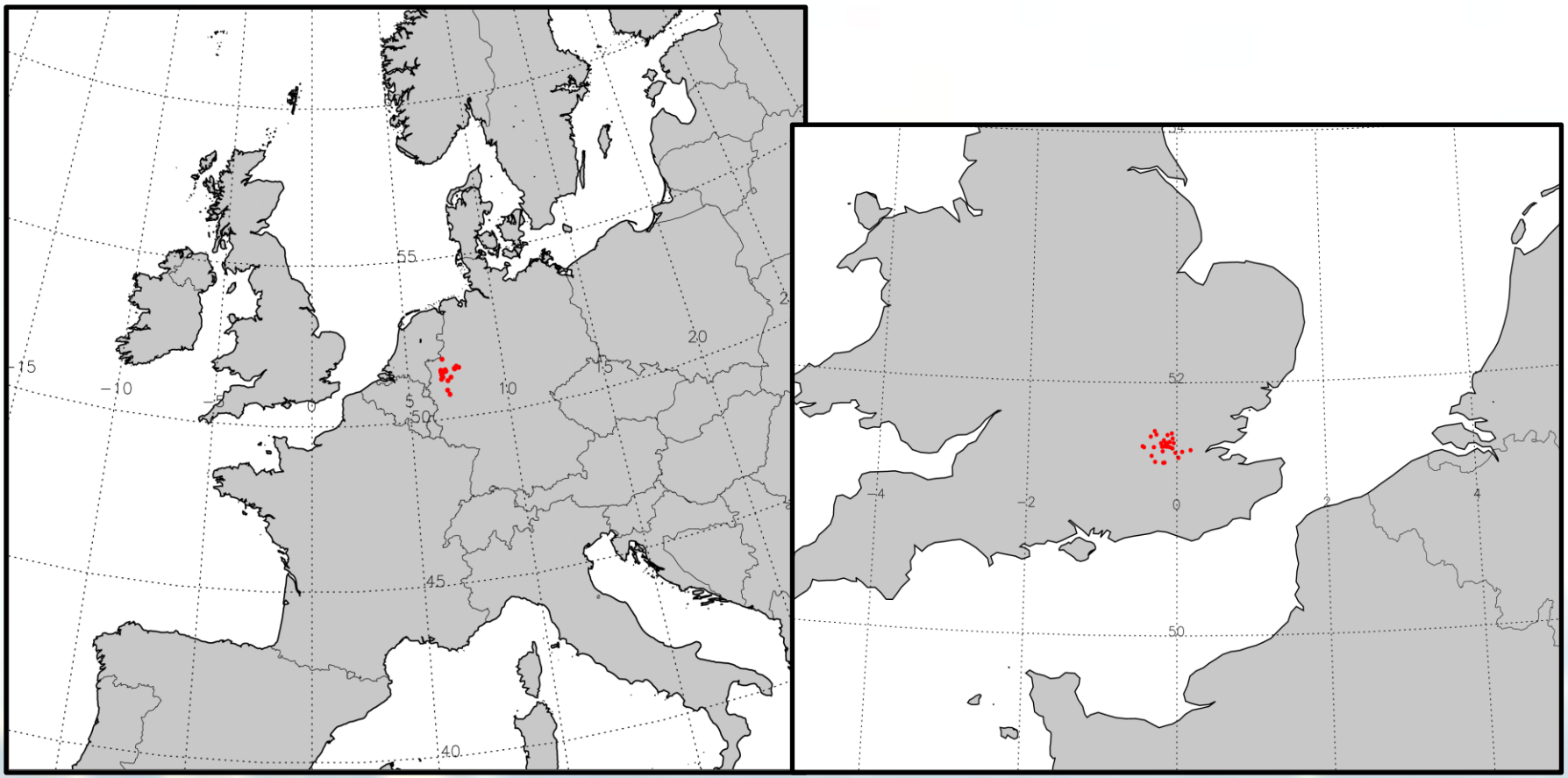
Model domain

Observation data sets – pollutant concentrations

	Rhine-Ruhr	Greater London	EMEP*
stations	Up to 20	Up to 37	Up to 65
Pollutants	O_3, PM10, PM2.5, NO_2, SO_2,	O_3, PM10, PM2.5, NO_2, NO, SO2	O_3, PM10, PM2.5
Automatic continuous measurements	✓	✓	✓
Rural stations	1	0	All
Suburban stations	9	4	0
Urban / traffic stations	10	33	0

* European Monitoring and Evaluation Programme

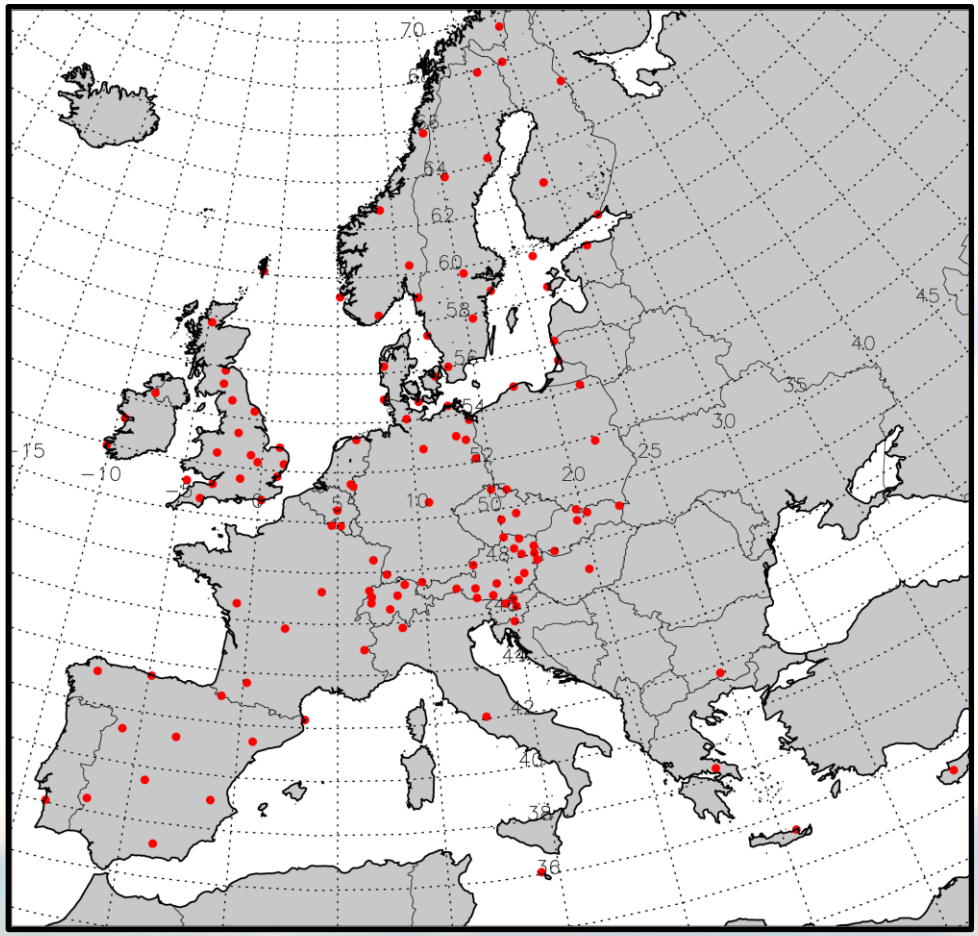
Stations in Europe: Rhine-Ruhr / London



Rhine-Ruhr

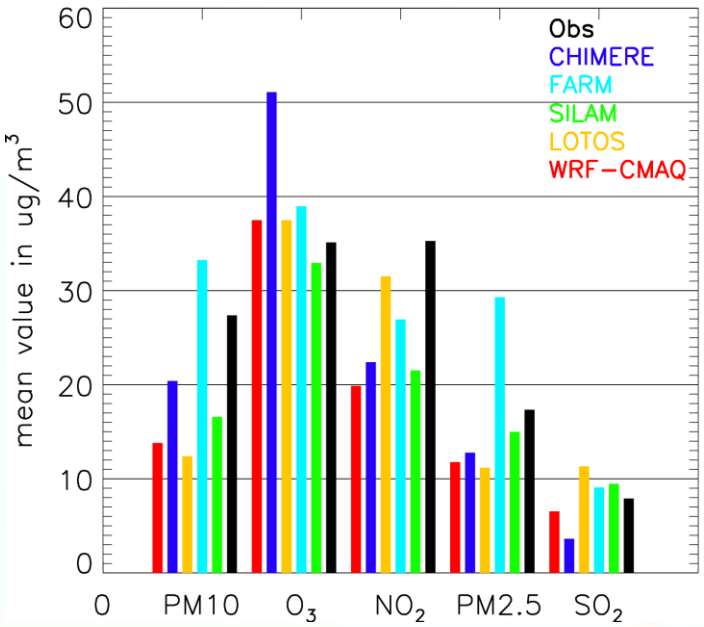
Greater London area

Stations in Europe: EMEP

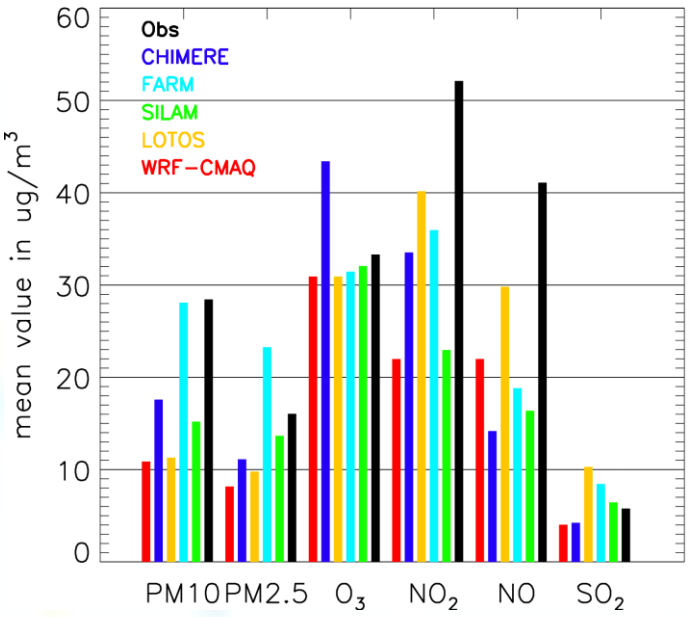


EMEP station network

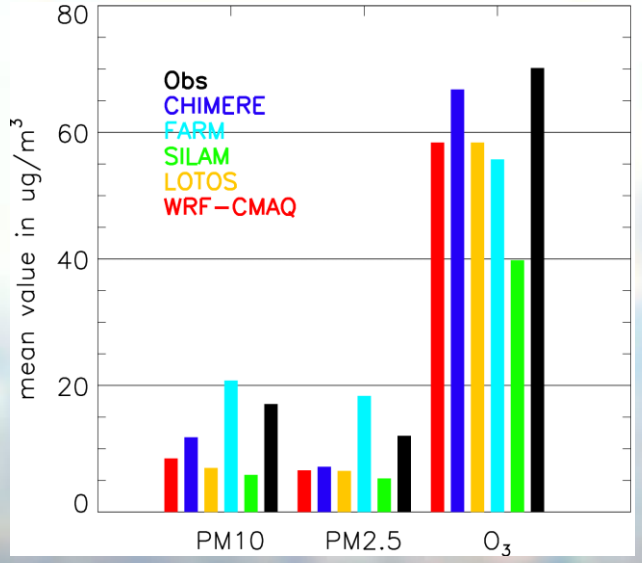
Operational evaluation: Annual means



Rhine-Ruhr

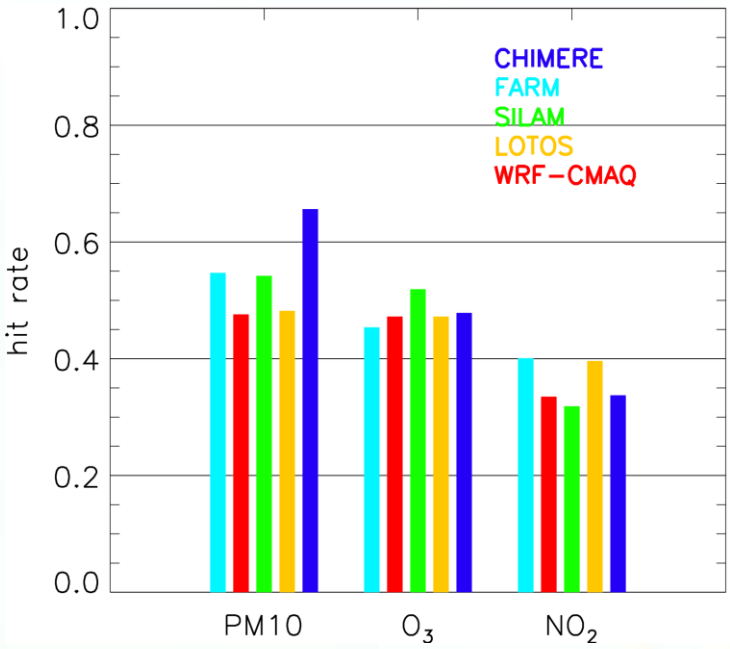


Greater London

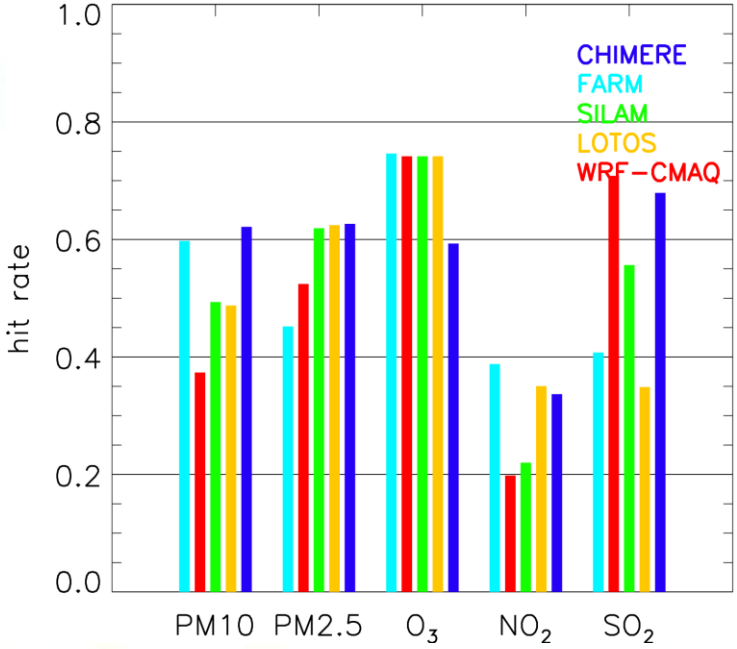


EMEP

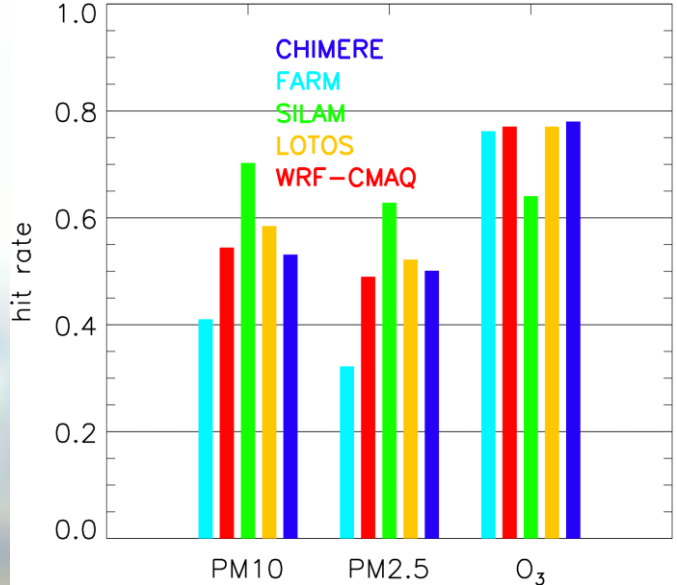
Operational evaluation: Hit rate



Rhine-Ruhr



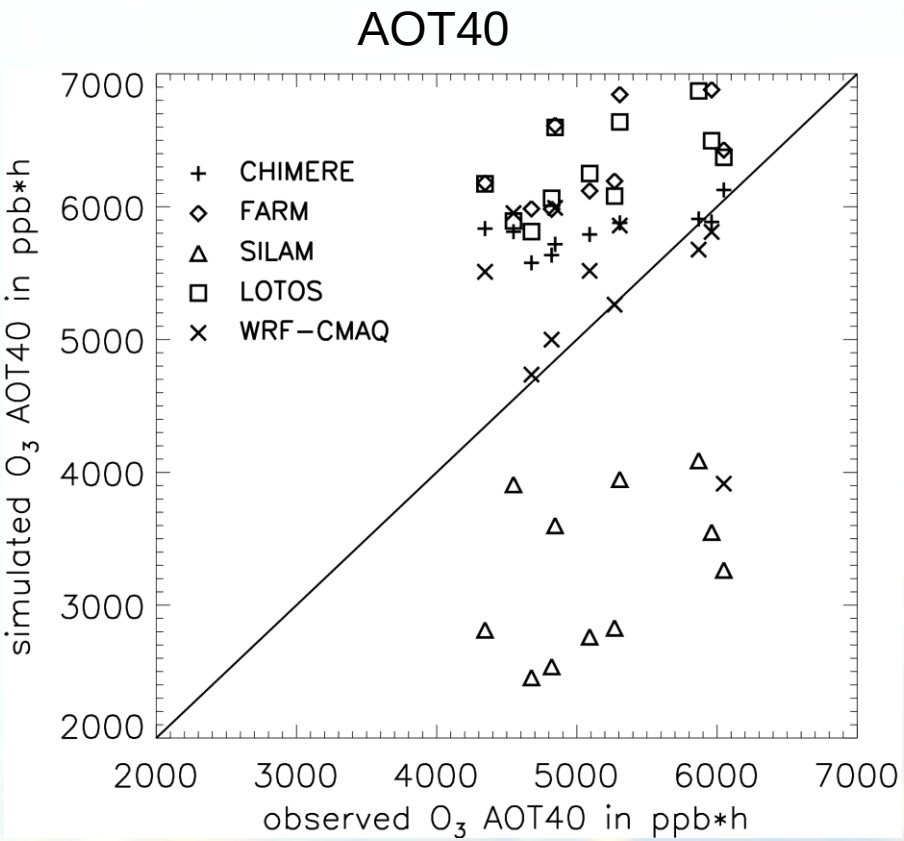
Greater London



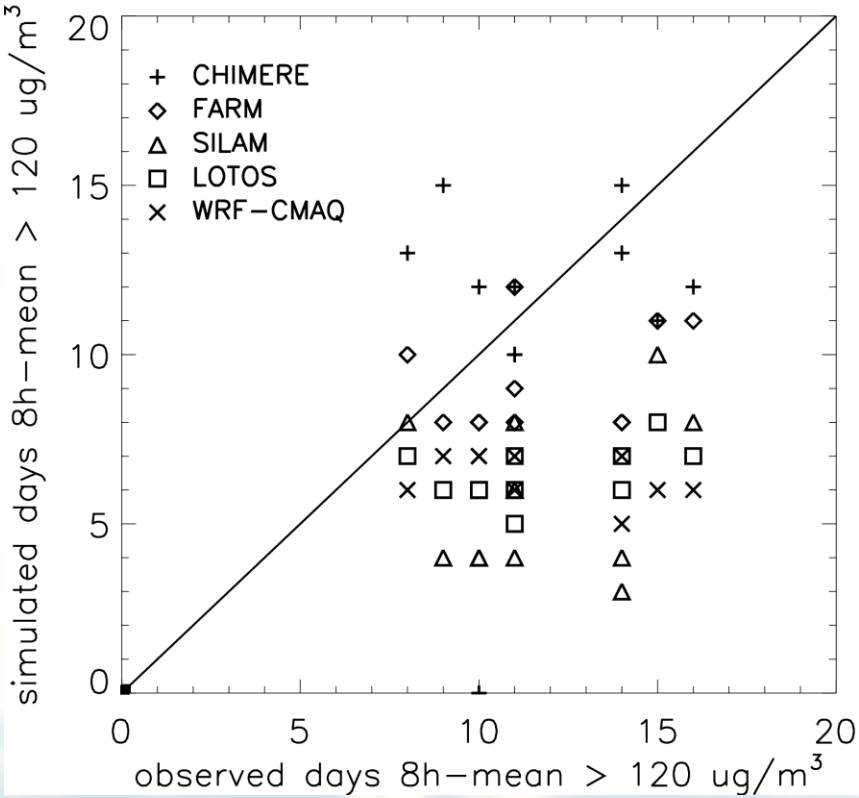
EMEP

Evaluation neglecting timing: O_3

Accumulated values:

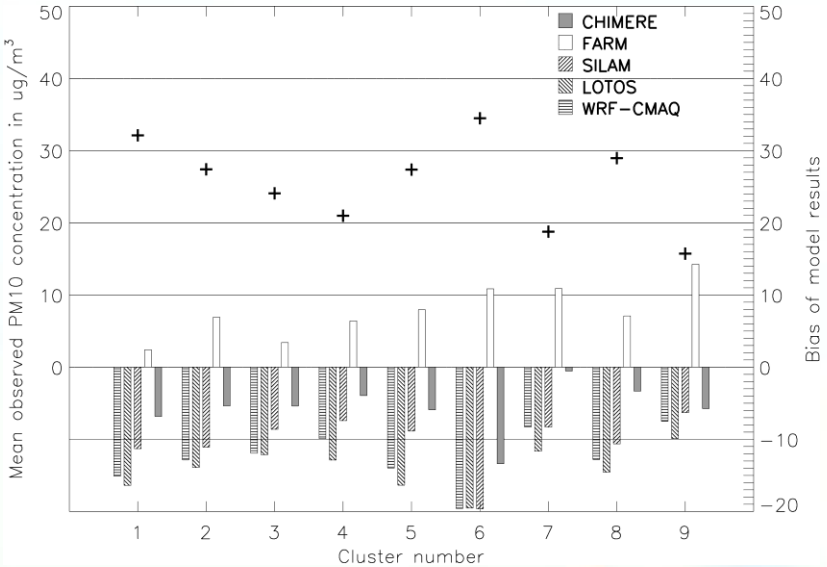


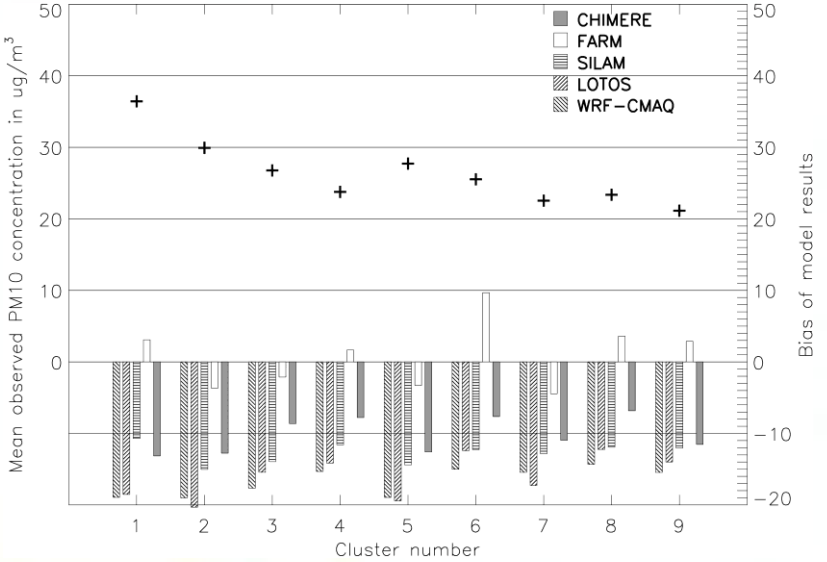
Number of exceedances:



Rhine-Ruhr

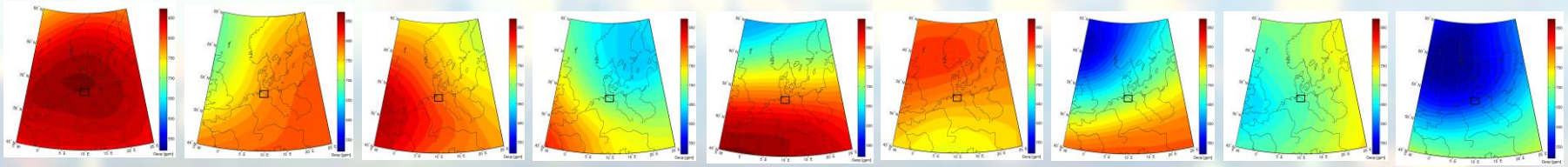
Evaluation for different weather types:PM10





Rhine-Ruhr

Greater London



1 2 3 4 5 6 7 8 9

Meteorol. Inst. - MeMi Group

Conclusions

- **Evaluation scheme applied to five models: CHIMERE, FARM, SILAM, LOTOS-EUROS and WRF-CMAQ**
- **Operational evaluation results are okay for most pollutant concentrations**
- **Nearly no dependance on station site characteristics**
- **Best results for ozone (hit rates ≈ 0.5-0.75, r ≈ 0.8, skvar ≈ 1.0)**
- **Overestimation of accumulated O_3 values by most models**
- **Number of exceedances: Underestimation of high O_3 concentrations**
- **Under/Overestimations found more or less at all 9 weather types → only small dependance of model performance on weather types**

Conclusions

» Are regional chemical tranport models (CTM) able to simulate urban pollutant concentrations? «

- Annual values of pollutant concentrations:
  okay, known
- Accumulated values and exceedanes:
  rather poor

Thank you for your attention!